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Response of epigeic spiders on the changes in the hydrological conditions in the Danube floodplain (area Gabčíkovo).

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Response of epigeic spiders on the changes in the hydrological conditions in the Danube floodplain (area Gabčíkovo). - In 1991-1994 the spiders (Araneae) of the floodplain forests at the locality Dobrohošť in the area of the waterworks Gabčíkovo (Slovakia) were studied. During this period 5 875 individuals belonging to 110 species were collected. During four years dominant species were *Pirata hygrophilus*, *Pardosa lugubris*, *Diplostyla concolor*, *Ozyptila praticola*, *Pachygnatha listeri*, *Lepthyphantes pallidus*, *Centromerus sylvaticus*. After the waterworks began operating (in November 1992) abundance of hygrophilous species till the year 1994 decreased about 26%, while abundance of eurytopic species increased about 30%. The structure of spiders community changed considerably. Spectrum of species increased from 35 up to 71.

Key-words: Epigeic spiders - floodplain forests - Danube river - waterworks.

INTRODUCTION

Floodplain forests in the Middle Europe represent an interesting type of biotope, which is reflected by their fauna. Araneofauna is not an exception either. It has been studied by many authors. The araneofauna of floodplain forests of the Danube river in Germany was studied by Bauchhenß (1991), in Austria by Thaler *et al.* (1984), Thaler & Steiner (1989), in Slovakia by Gajdoš et al. (1992), Gajdoš (1995), Čarnogursky *et al.* (1994), Krumpálová & Krumpál (1993), Krumpálová (1995).

The construction and operation of the waterworks Gabčíkovo on the Danube and consequent changes in hydrological regime, was the reason for research of the changes in flora and fauna in these floodplain forests. The study of the araneofauna

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was a part of this investigation. This work deals with an epigeic spider community of the soft floodplain forest in one of the many study plots.

MATERIAL AND METHODS

In 1991-1994 we studied the araneofauna of the floodplain forests in Dobrohošt' (Fig. 1). Spiders were collected using ten formalin pitfall traps (9 cm in diameter), in a line at intervals of 15 m. The traps were exposed from March to November and picked monthly. The continual caught was interrupted by floods for several times in 1991.

To classify the spiders from the point of view of their humidity requirements we took into the consideration our own notions as well as the works of MARTIN (1991), MILLER (1971) and HEIMER & NENTWIG (1991). The nomenclature was according to PLATNICK (1989).

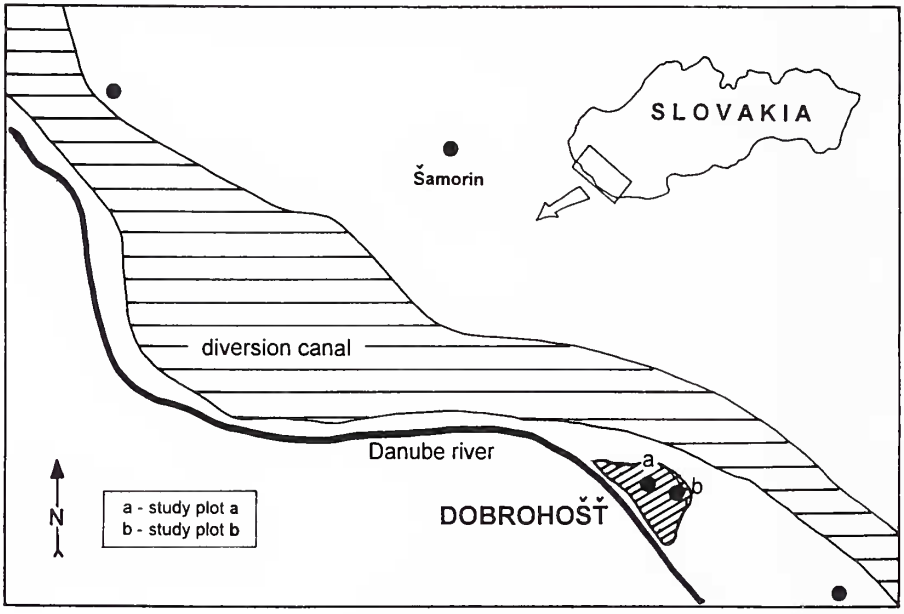

FIG. 1

The map of the part of waterworks Gabčikovo.

LOCALITY SPECIFICATION

Locality Dobrohošt' is situated along the old remnant arm with wet forest biotope. The forest vegetation belongs to the alliance *Salicion albae*, represented by *Populus alba*, *P. nigra* and *Salix alba* in the tree stage. The vegetation in the wet part belongs to the alliance *Phalaridion arundinaceae* and *Phragmition* (ČEJKA *et al.*

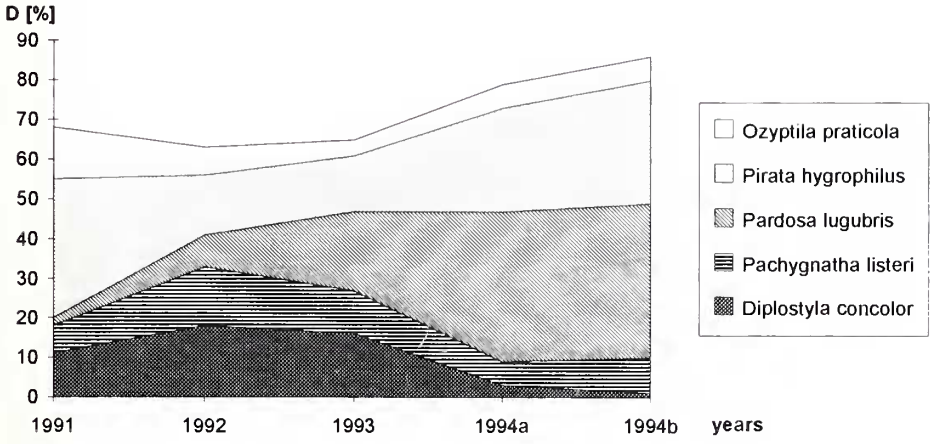

FIG. 2
Eudominant species of spiders at Dobrohošt' locality.

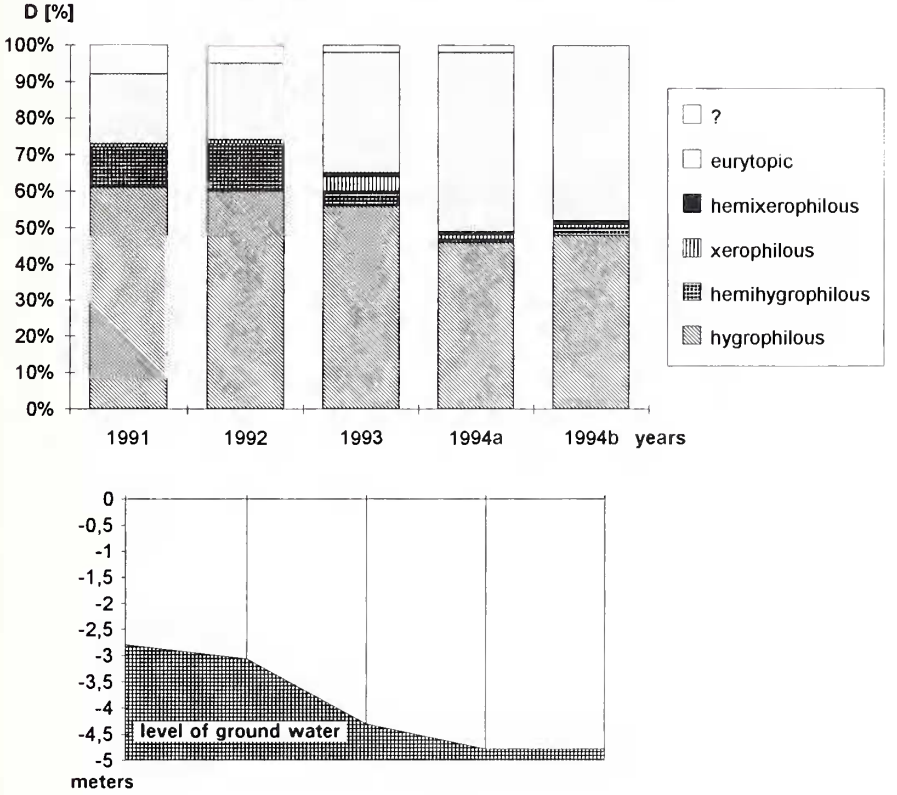

FIG. 3
The structure of spider communities at Dobrohost locality.

TAB. I

The dominance of spiders at Dobrohošt' locality during the years 1991-1994.

taxon	years	1991	1992	1993	1994	1994
Mimetidae						
1. *Ero furcata* (Villers, 1789)			0.38	0.3		
Theridiidae						
2. *Enoplognatha ovata* (Clerck, 1757)					0.05	
3. *Episinus angulatus* (Blackwall, 1836)		0.08		0.1		
4. *Robertus lividus* (Blackwall, 1836)		0.34	0.95	1.6	0.46	
5. *R. neglectus* (O.P. Cambridge, 1871)				0.1		
6. *Theridion pictum* (Walckenaer, 1802)						0.08
7. *T. pinastri* L.Koch, 1872			0.19			
Theridiosomatidae						
8. *Theridiosoma gemmosum* (L.Koch, 1877)				0.1		
Linyphiidae						
9. *Bathyphantes approximatus* (O.P. Cambridge,1871)						0.08
10. *Bathyphantes gracilis* (Blackwall, 1841)				0.1		
11. *B. nigrinus* (Westring, 1851)		2.18	7.82	3.3	0.41	0.17
12. *Bathyphantes setiger* F.O.P.Cambridge, 1894			0.19			
13. *Centromerus arcanus* (O.P.Cambridge, 1873)			0.38	0.1		
14. *C. levitarsis* (Simon, 1884)					0.05	
15. *C. sellarius* (Simon, 1884)				0.1		0.17
16. *C. sylvaticus* (Blackwall, 1841)			13.55	2.1	0.2	0.67
17. *Ceratinella brevipes* (Westring, 1851)					0.1	
18. *C. scabrosa* (O.P.Cambridge, 1871)				0.1	1.63	0.75
19. *Diplocephalus latifrons* (O.P. Cambridge, 1863)		3.53	0.57	0.1	0.36	0.25
20. *D. picinus* (Blackwall, 1841)		0.75	3.43	1.7	0.61	0.67
21. *Diplostyla concolor* (Wider, 1834)		11	18.32	15.9	2.65	0.75
22. *Entelecara congenera* (O.P.Cambridge, 1879)		7.98				
23. *Floronia bucculenta* (Clerck, 1757)		0.08		0.1		
24. *Gongilidium rufipes* (Linnaeus, 1758)		0.92	0.95	0.8	0.1	0.17
25. *Leptlyphantes flavipes* (Blackwall, 1854)				0.2	0.05	0.5
26. *L. mengei* Kulczynski, 1887				0.4		
27. *L. nodifer* Simon, 1884				0.2		
28. *L. pallidus* (O.P. Cambridge, 1871)		0.34	4.01	7.7	0.1	
29. *L. tenebricola* (Wider, 1834)		6.05		0.2	0.15	
30. *Linyphia hortensis* Sundevall, 1830					0.05	
31. *L. triangularis* (Clerck,1757)		0.34			0.05	
32. *Neriene clathrata* (Sundevall, 1830)			0.57	1.3	0.92	0.67
33. *N. furtiva* (O.P. Cambridge, 1871)				0.4	0.05	
34. *N. montana* (Clerck, 1757)			0.19	0.3	0.1	0.33
35. *N. radiata* (Walckenaer, 1841)					0.05	
36. *Oedothorax retusus* (Westring, 1851)					0.92	0.92
37. *Panamomops affinis* Miller & Kratochvil, 1939					0.05	
38. *Porrhomma convexum* (Westring, 1861)		0.34				
39. *Porrhomma* sp.			0.19			
40. *Tapinocyba insecta* (L.Koch, 1869)					0.05	
41. *Tmeticus affinis* (Blackwall, 1855)					0.05	
42. *Trichopterna cito* (O.P. Cambridge, 1872)					0.05	
43. *Walckenaeria antica* (Wider, 1834)				1.2	0.05	0.25

44. *W. nodosa* O.P. Cambridge, 1873				0.05	
45. *W. nudipalpis* (Westring, 1851)			0.5	0.15	0.17
46. *W. obtusa* Blackwall, 1836		0.57	0.4	0.92	0.42
47. *W. vigilax* (Blackwall, 1853)				0.05	
48. Linyphiidae gen.sp.		1.91	1.7	0.82	0.08
Tetragnathidae					
49. *Metelina mengei* (Blackwall, 1869)	0.17				
50. *M. segmentata* (Clerck, 1757)	0.67	0.19	0.5		
51. *Pachygnatha clercki* Sundevall, 1823	1.18	0.19	0.1		0.17
52. *P. listeri* Sundevall, 1830	7.39	15.46	11.5	5.56	9.43
53. *Tetragnatha extensa* (Linnaeus, 1758)	0.42		0.2		
54. *T. montana* Simon, 1874	0.08				
55. *T. obtusa* C.L.Koch, 1837				0.05	
56. *T. pinicola* L.Koch, 1870			0.1		
Araneidae					
57. *Agalenatea redii* (Scopoli, 1763)		0.19	0.2		
58. *Araneus alsine* (Walckenaer, 1802)				0.05	
59. *A. diadematus* Clerck, 1757	0.25		0.2		
60. *A. marmoreus* Clerck, 1757	0.08	0.19	0.1		
61. *Araniella cucurbitina* (Clerck, 1757)				0.05	
62. *Gibbaranea gibbosa* (Walckenaer, 1802)			0.2	0.11	
63. *Hypsosinga sanguinea* (C.L.Koch, 1844)	0.17				
64. *Larinioides patagiatus* (Clerck, 1757)		0.19	0.1		
65. *L. sclopetarius* (Clerck, 1757)				0.05	
66. *Neoscona adianta* (Walckenaer, 1802)			0.1	0.05	
Lycosidae					
67. *Alopecosa aculeata* (Clerck, 1757)				0.25	
68. *A. pulverulenta* (Clerck, 1757)				0.05	
69. *Pardosa amentata* (Clerck, 1757)	0.42		0.1	4.44	0.42
70. *Pardosa lugubris* (Walckenaer, 1802)	2.27	7.82	20.1	38.14	39.48
71. *P. paludicola* (Clerck, 1757)	0.08			0.05	
72. *Pirata hygrophilus* Thorell, 1872	34.59	14.69	14.3	25.85	31.3
73. *P. latitans* (Blackwall, 1841)				0.77	0.5
74. *P. piraticus* (Clerck, 1757)	1.34	0.19	0.1	0.25	
75. *Trochosa robusta* (Simon, 1876)				0.05	
76. *T. ruricola* (De Geer, 1778)			0.2	0.66	0.5
77. *T. terricola* Thorell, 1856				0.05	
Pisauridae					
78. *Pisaura mirabilis* (Clerck, 1757)			0.9	0.71	0.33
Agelenidae					
79. *Agelena gracilens* C.L.Koch, 1841			0.2		
80. *Tegenaria campestris* C.L.Koch, 1834				0.05	0.75
81. *T. ferruginea* (Panzer, 1804)				0.05	0.08
Hahniidae					
82. *Cryphoeca silvicola* (C.L.Koch, 1834)				0.05	
Dictynidae					
83. *Dictyna uncinata* Thorell, 1856	0.25				
Liocranidae					
84. *Agraecina striata* (Kulczynski, 1882)	1.18	0.95	0.3	2.14	2.25
85. *Agroeca brunnea* (Blackwall, 1833)	0.42	0.76	1	1.53	1
86. *A. lusatica* (L.Koch, 1875)			0.5		
87. *Phrurolitus festivus* (C.L.Koch, 1835)	0.17	0.38	0.5	0.11	
Clubionidae					
88. *Clubiona brevipes* Blackwall, 1841			0.1		0.08
89. *C. caerulescens* L.Koch, 1867		0.38	0.2	0.05	0.08

90.	*C. lutescens* Westring, 1851	0.59		0.3		
91.	*C. neglecta* O.P. Cambridge, 1862		0.19	0.1	0.05	
92.	*C. pallidula* (Clerck, 1757)				0.05	
93.	*C. reclusa* O.P. Cambgidge, 1863				0.05	
94.	*C. similis* L. Koch, 1867			0.2		
95.	*C. terrestris* Westring, 1851			0.1		
96.	*Clubiona* sp.		3.81	1	0.36	0.33
	Gnaphosidae					
97.	*Zelotes aeneus* (Simon, 1878)			0.2		
98.	*Z. apricorum* (L. Koch, 1876)				0.05	
99.	*Z. electus* (C.L. Koch, 1839)				0.11	
100.	*Z. lutetianus* (L. Koch, 1866)			0.1	0.05	
101.	*Z. subterraneus* (C.L. Koch, 1833)			0.6	0.25	0.08
102.	*Z. villicus* (Thorell, 1875)	1.01			0.05	0.08
103.	*Zelotes* sp.			0.1	0.31	
	Zoridae					
104.	*Zora pardalis* Simon, 1878					0.08
105.	*Z. silvestris* Kulczynski, 1897					0.17
106.	*Z. spinimana* (Sundevall, 1833)	0.17				0.08
	Thomisidae					
107.	*Diaea dorsata* (Fabricius, 1777)				0.05	
108.	*Ozyptila praticola* (C.L. Koch, 1837)	13.18	7.25	4.4	6.02	5.68
109.	*Xysticus bifasciatus* C.L. Koch, 1837				0.05	
	Salticidae					
110.	*Ballus chalybeius* (Walckenaer,1802)				0.11	
	Sum of individuals	1191	524	1000	1962	1198
	Sum of species	35	33	62	71	39

1995). After the diversion of the Danube river into the diversion canal of Gabčíkovo waterworks in 1992 the old remnant arm at the locality Dobrohošt' dried up. Since this year we have recorded a continual decline in the ground water level, about 2 m, and in 1994 it was stabilized relatively at a depth of 4.8 m (Fig. 3). Absence of natural floods (the last flood was in August 1991) has also contributed to the changes in hydrological regime at the biotope. Until 1994 the previous number of willows reduced at 45%, all the species exhibit loss of foliage and precocious downfall of leaves. The present site - conditions are suitable for establishment of hardwood floodplain forest (Pišút 1994).

In 1994 also the other study plot (in the text marked as "b"), where floods should be simulated, was investigated.

RESULTS

During four years of our research at the locality Dobrohošt' 5 875 individuals, belonging to 110 species from 17 families were obtained (Tab. 1).

In 1991 - 35 spider species were found there. Eudominant species were represented by *Pirata hygrophilus* 34.6%, *Ozyptila praticola* 13.2%, *Diplostyla concolor* 11%, dominant species were *Pachygnatha listeri* 7.4%, *Entelecara congenera* 8%, *Lepthyphantes tenebricola* 6% (Fig. 2).

In 1992 - 33 spider species were recorded. Eudominant species were *Diplostyla concolor* 18.3%, *Pachygnatha listeri* 15.5%, *Pirata hygrophilus* 14.7%, *Centromerus sylvaticus* 13.6%, dominant species were *Bathyphantes nigrinus* 7.8%, *Pardosa lugubris* 7.8%, *Ozyptila praticola* 7.3%.

In 1993 - 62 spider species were found at this locality. Eudominant species were *Pardosa lugubris* 20.1%, *Diplostyla concolor* 15.9%, *Pirata hygrophilus* 14.3%, *Pachygnatha listeri* 11.5%, dominant was *Lepthyphantes pallidus* 7.7%.

In 1994 the number of recorded spider species was 71. Eudominant were *Pardosa lugubris* 38.1%, *Pirata hygrophilus* 25.9%, dominant species were *Ozyptila praticola* 6% and *Pachygnatha listeri* 5.6%.

In the same year in the study plot "b" 39 spider species were found. Eudominant were *Pardosa lugubris* 39.5%, *Pirata hygrophilus* 31.3%; dominant species were *Pachygnatha listeri* 9.4% and *Ozyptila praticola* 5.7%.

Concerning the eudominant and dominant species on the one hand a decrease in abundance of *Pirata hygrophilus* (about 20%) and *Ozyptila praticola* (about 7%) was recorded during the investigated period, on the other hand an increase in abundance was the most expressive in *Pardosa lugubris* (about 36%). Increased abundance of spiders *Pachygnatha listeri* (4%), *Diplostyla concolor* (5-7%), *Lepthyphantes pallidus* (7%), was also recorded, although in 1994 a decline in abundance of these species was found (Fig. 2). The abundance of *Pirata hygrophilus* increased this year.

The structure of spider community was changing considerably during the years 1991 - 1994. The most marked change was the quantitative growth of species from the families Linyphiidae and Theridiidae, especially. The total spectrum of spider species was increasing. In the year 1991 - 13 species belonging to the families Linyphiidae and Theridiidae were found there, in 1992 - 15 spider species, in 1993 - 26 species and in 1994 - 30 species. Since 1992 their dominance in the community has been indirectly proportionate to the growing number of species. In 1991 they represented 34 % of all individuals , in 1992 - 54%, in 1993 - 41% and in 1994 only 11%. Since 1992 the hydrological conditions at the biotope have changed. Besides the changing hydrological conditions at the biotope the araneofauna was affected by dry, warm and long-lasting summer-autumnal part of the season in recent yaers. The occurence of small spider species, especially hygrophilous ones from the families Linyphiidae and Theridiidae, was concentrated gradually into the microhabitats in proximity of trees, small shrubs and ground depressions. During the year 1993, but mostly in 1994 the stenotopic species had been replaced by eurytopic ones. The penetration of the expansive species *Pardosa lugubris* into the biotope caused a competitive pressure on the abundance of smaller species of spiders. Similar expansive reaction was seen by the hygrophilous species *Pirata hygrophilus*. In comparison with the year 1993 the dominance of this species increased about 12% in consequence of its greater migratory ability. We can suppose that species diversity will gradually stabilize, whereby the structure of the community will be different from that of 1992, which is connected with the changed conditions at the biotope.

Response of the spiders to the changes in hydrologic conditions was very

conspicious and rapid. The change in the structure of the community was manifested not only in the species spectrum but also in the number of spiders preferring wet or inundated biotopes.

In the years 1991-1992 the spider community was represented mainly by the hygrophilous and hemihygrophilous species (Fig. 3), the eurytopic and xerophilous species represented about 20%. In 1993 we recorded a decline in abundance of the hygrophilous and hemihygrophilous species that was more expressive in 1994 (about 26%). This decrease in abundance of the hygrophilous species was compensated by an increase in abundance of the eurytopic species (in 1993 about 13% and in 1994 about 30%) (Fig. 3).

DISCUSSION

The spider community of the Danube floodplain forests is represented by 30 - 40 species (THALER *et al.* 1984, THALER & STEINER 1989, BAUCHHENß 1991, KRUMPÁLOVÁ, in press).

The epigeic fauna of spiders of the Danube floodplain forests is markedly affected especially by two factors: the ground water level (and the soil humidity connected with this, as well) and the floods. It is expressed remarkably not only in the abundance but also in the number of species.

In connection with the construction and working of Gabčíkovo waterworks, at the locality Dobrohošt', conditions for transition of soft floodplain forest to hard floodplain forest have been estabilished (Pišút 1994). However, the structure of spider community at the biotope exhibits for the present very low similarity with the composition of the spider communities in the floodplain forests near Vienna (THALER & STEINER 1989) or near Dillingen (BAUCHHENß 1991).

The next research of the araneofauna at the locality Dobrohošt' will show, wheater the changes in the spider communities structure are permanent and it will make possible to prepare a model of changes in the spider communities of the Danube floodplain forests.

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